Agency for Healthcare Research and Quality
Advancing Excellence in Health Care

NATIONAL GUIDELINE CLEARINGHOUSE

General

Guideline Title

Clinical practice guidelines by the Infectious Diseases Society of America for the treatment of methicillin-resistant *Staphylococcus aureus* infections in adults and children.

Bibliographic Source(s)

Liu C, Bayer A, Cosgrove SE, Daum RS, Fridkin SK, Gorwitz RJ, Kaplan SL, Karchmer AW, Levine DP, Murray BE, Rybak MJ, Talan DA, Chambers HF. Clinical practice guidelines by the Infectious Diseases Society of America for the treatment of methicillin-resistant staphylococcus aureus infections in adults and children. Clin Infect Dis. 2011 Feb;52:1-38. [371 references]

Guideline Status

This is the current release of the guideline.

Recommendations

Major Recommendations

Quality of evidence (I–III) and strength of recommendation (A–C) ratings are defined at the end of the "Major Recommendations" field.

What is the management of skin and soft-tissue infections (SSTIs) in the era of community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA)?

SSTIs

1. For a cutaneous abscess, incision and drainage is the primary treatment (A-II). For simple abscesses or boils, incision and drainage alone is likely to be adequate, but additional data are needed to further define the role of antibiotics, if any, in this setting.
2. Antibiotic therapy is recommended for abscesses associated with the following conditions: severe or extensive disease (e.g., involving multiple sites of infection) or rapid progression in presence of associated cellulitis, signs and symptoms of systemic illness, associated comorbidities or immunosuppression, extremes of age, abscess in an area difficult to drain (e.g., face, hand, and genitalia), associated septic phlebitis, and lack of response to incision and drainage alone (A-III).
3. For outpatients with purulent cellulitis (e.g., cellulitis associated with purulent drainage or exudate in the absence of a drainable abscess), empirical therapy for CA-MRSA is recommended pending culture results. Empirical therapy for infection due to beta-hemolytic streptococci is likely to be unnecessary (A-II). Five to 10 days of therapy is recommended but should be individualized on the basis of the patient's clinical response.
4. For outpatients with nonpurulent cellulitis (e.g., cellulitis with no purulent drainage or exudate and no associated abscess), empirical therapy for infection due to beta-hemolytic streptococci is recommended (A-II). The role of CA-MRSA is unknown. Empirical coverage for CA-

MRSA is recommended in patients who do not respond to beta-lactam therapy and may be considered in those with systemic toxicity. Five to 10 days of therapy is recommended but should be individualized on the basis of the patient's clinical response.

5. For empirical coverage of CA-MRSA in outpatients with SSTI, oral antibiotic options include the following: clindamycin (A-II), trimethoprim-sulfamethoxazole (TMP-SMX) (A-II), a tetracycline (doxycycline or minocycline) (A-II), and linezolid (A-II). If coverage for both beta-hemolytic streptococci and CA-MRSA is desired, options include the following: clindamycin alone (A-II) or TMP-SMX or a tetracycline in combination with a beta-lactam (e.g., amoxicillin) (A-II) or linezolid alone (A-II).
6. The use of rifampin as a single agent or as adjunctive therapy for the treatment of SSTIs is not recommended (A-III).
7. For hospitalized patients with complicated SSTIs (cSSTIs; defined as patients with deeper soft-tissue infections, surgical/traumatic wound infection, major abscesses, cellulitis, and infected ulcers and burns), in addition to surgical debridement and broad-spectrum antibiotics, empirical therapy for MRSA should be considered pending culture data. Options include the following: intravenous (IV) vancomycin (A-I), oral (PO) or IV linezolid 600 mg twice daily (A-I), daptomycin 4 mg/kg/dose IV once daily (A-I), telavancin 10 mg/kg/dose IV once daily (A-I), and clindamycin 600 mg IV or PO 3 times a day (A-III). A beta-lactam antibiotic (e.g., cefazolin) may be considered in hospitalized patients with nonpurulent cellulitis with modification to MRSA-active therapy if there is no clinical response (A-II). Seven to 14 days of therapy is recommended but should be individualized on the basis of the patient's clinical response.
8. Cultures from abscesses and other purulent SSTIs are recommended in patients treated with antibiotic therapy, patients with severe local infection or signs of systemic illness, patients who have not responded adequately to initial treatment, and if there is concern for a cluster or outbreak (A-III).

Pediatric Considerations

9. For children with minor skin infections (such as impetigo) and secondarily infected skin lesions (such as eczema, ulcers, or lacerations), mupirocin 2% topical ointment can be used (A-III).
10. Tetracyclines should not be used in children <8 years of age (A-II).
11. In hospitalized children with cSSTIs, vancomycin is recommended (A-II). If the patient is stable without ongoing bacteremia or intravascular infection, empirical therapy with clindamycin 10–13 mg/kg/dose IV every 6–8 hours (to administer 40 mg/kg/day) is an option if the clindamycin resistance rate is low (e.g., <10%) with transition to oral therapy if the strain is susceptible (A-II). Linezolid 600 mg PO/IV twice daily for children ≥12 years of age and 10 mg/kg/dose PO/IV every 8 hours for children <12 years of age is an alternative (A-II).

What is the management of recurrent MRSA SSTIs?

Recurrent SSTIs

12. Preventive educational messages on personal hygiene and appropriate wound care are recommended for all patients with SSTIs. Instructions should be provided to:
    i. Keep draining wounds covered with clean, dry bandages (A-III).
    ii. Maintain good personal hygiene with regular bathing and cleaning of hands with soap and water or an alcohol-based hand gel, particularly after touching infected skin or an item that has directly contacted a draining wound (A-III).
    iii. Avoid reusing or sharing personal items (e.g., disposable razors, linens, and towels) that have contacted infected skin (A-III).

13. Environmental hygiene measures should be considered in patients with recurrent SSTI in the household or community setting:
    i. Focus cleaning efforts on high-touch surfaces (i.e., surfaces that come into frequent contact with people's bare skin each day, such as counters, door knobs, bath tubs, and toilet seats) that may contact bare skin or uncovered infections (C-III).
    ii. Commercially available cleaners or detergents appropriate for the surface being cleaned should be used according to label instructions for routine cleaning of surfaces (C-III).

14. Decolonization may be considered in selected cases if:
    i. A patient develops a recurrent SSTI despite optimizing wound care and hygiene measures (C-III).
    ii. Ongoing transmission is occurring among household members or other close contacts despite optimizing wound care and hygiene measures (C-III).

15. Decolonization strategies should be offered in conjunction with ongoing reinforcement of hygiene measures and may include the following:
    i. Nasal decolonization with mupirocin twice daily for 5–10 days (C-III).
    ii. Nasal decolonization with mupirocin twice daily for 5–10 days and topical body decolonization regimens with a skin antiseptic solution (e.g., chlorhexidine) for 5–14 days or dilute bleach baths. (For dilute bleach baths, 1 teaspoon per gallon of water [or ¼ cup per ¼ tub or 13 gallons of water] given for 15 min twice weekly for ~3 months can be considered.) (C-III).

16. Oral antimicrobial therapy is recommended for the treatment of active infection only and is not routinely recommended for decolonization

(A-III). An oral agent in combination with rifampin, if the strain is susceptible, may be considered for decolonization if infections recur despite above measures (C-III).

17. In cases where household or interpersonal transmission is suspected:
    i. Personal and environmental hygiene measures in the patient and contacts are recommended (A-III).
    ii. Contacts should be evaluated for evidence of *Staphylococcus aureus* (*S. aureus*) infection:
        a. Symptomatic contacts should be evaluated and treated (A-III); nasal and topical body decolonization strategies may be considered following treatment of active infection (C-III).
        b. Nasal and topical body decolonization of asymptomatic household contacts may be considered (C-III).

18. The role of cultures in the management of patients with recurrent SSTI is limited:
    i. Screening cultures prior to decolonization are not routinely recommended if at least 1 of the prior infections was documented as due to MRSA (B-III).
    ii. Surveillance cultures following a decolonization regimen are not routinely recommended in the absence of an active infection (B-III).

What is the management of MRSA bacteremia and infective endocarditis?

Bacteremia and Infective Endocarditis, Native Valve

19. For adults with uncomplicated bacteremia (defined as patients with positive blood culture results and the following: exclusion of endocarditis; no implanted prostheses; follow-up blood cultures performed on specimens obtained 2–4 days after the initial set that do not grow MRSA; defervescence within 72 hours of initiating effective therapy; and no evidence of metastatic sites of infection), vancomycin (A-II) or daptomycin 6 mg/kg/dose IV once daily (A-I) for at least 2 weeks. For complicated bacteremia (defined as patients with positive blood culture results who do not meet criteria for uncomplicated bacteremia), 4–6 weeks of therapy is recommended, depending on the extent of infection. Some experts recommend higher dosages of daptomycin at 8–10 mg/kg/dose IV once daily (B-III).
20. For adults with infective endocarditis, IV vancomycin (A-II) or daptomycin 6 mg/kg/dose IV once daily (A-I) for 6 weeks is recommended. Some experts recommend higher dosages of daptomycin at 8–10 mg/kg/dose IV once daily (B-III).
21. Addition of gentamicin to vancomycin is not recommended for bacteremia or native valve infective endocarditis (A-II).
22. Addition of rifampin to vancomycin is not recommended for bacteremia or native valve infective endocarditis (A-I).
23. A clinical assessment to identify the source and extent of the infection with elimination and/or debridement of other sites of infection should be conducted (A-II).
24. Additional blood cultures 2–4 days after initial positive cultures and as needed thereafter are recommended to document clearance of bacteremia (A-II).
25. Echocardiography is recommended for all adult patients with bacteremia. Transesophageal echocardiography (TEE) is preferred over transthoracic echocardiography (TTE) (A-II).
26. Evaluation for valve replacement surgery is recommended if large vegetation (>10 mm in diameter), occurrence of ≥1 embolic event during the first 2 weeks of therapy, severe valvular insufficiency, valvular perforation or dehiscence, decompensated heart failure, perivalvular or myocardial abscess, new heart block, or persistent fevers or bacteremia are present (A-II).

Infective Endocarditis, Prosthetic Valve

27. IV vancomycin plus rifampin 300 mg PO/IV every 8 hours for at least 6 weeks plus gentamicin 1 mg/kg/dose IV every 8 hours for 2 weeks (B-III).
28. Early evaluation for valve replacement surgery is recommended (A-II).

Pediatric Considerations

29. In children, vancomycin 15 mg/kg/dose IV every 6 hours is recommended for the treatment of bacteremia and infective endocarditis (A-II). Duration of therapy may range from 2 to 6 weeks depending on source, presence of endovascular infection, and metastatic foci of infection. Data regarding the safety and efficacy of alternative agents in children are limited, although daptomycin 6-10 mg/kg/dose IV once daily may be an option (C-III). Clindamycin or linezolid should not be used if there is concern for infective endocarditis or endovascular source of infection but may be considered in children whose bacteremia rapidly clears and is not related to an endovascular focus (B-III).
30. Data are insufficient to support the routine use of combination therapy with rifampin or gentamicin in children with bacteremia or infective endocarditis (C-III); the decision to use combination therapy should be individualized.
31. Echocardiogram is recommended in children with congenital heart disease, bacteremia more than 2–3 days in duration, or other clinical findings suggestive of endocarditis (A-III).

What is the management of MRSA pneumonia?

Pneumonia

32. For hospitalized patients with severe community-acquired pneumonia defined by any one of the following: (1) a requirement for intensive care unit (ICU) admission, (2) necrotizing or cavitary infiltrates, or (3) empyema, empirical therapy for MRSA is recommended pending sputum and/or blood culture results (A-III).
33. For health care–associated MRSA (HA-MRSA) or CA-MRSA pneumonia, IV vancomycin (A-II) or linezolid 600 mg PO/IV twice daily (A-II) or clindamycin 600 mg PO/IV 3 times daily (B-III), if the strain is susceptible, is recommended for 7–21 days, depending on the extent of infection.
34. In patients with MRSA pneumonia complicated by empyema, antimicrobial therapy against MRSA should be used in conjunction with drainage procedures (A-III).

Pediatric Considerations

35. In children, IV vancomycin is recommended (A-II). If the patient is stable without ongoing bacteremia or intravascular infection, clindamycin 10–13 mg/kg/dose IV every 6–8 hours (to administer 40 mg/kg/day) can be used as empirical therapy if the clindamycin resistance rate is low (e.g., <10%) with transition to oral therapy if the strain is susceptible (A-II). Linezolid 600 mg PO/IV twice daily for children ≥12 years of age and 10 mg/kg/dose every 8 hours for children <12 years of age is an alternative (A-II).

What is the management of MRSA bone and joint infections?

Osteomyelitis

36. Surgical debridement and drainage of associated soft-tissue abscesses is the mainstay of therapy and should be performed whenever feasible (A-II).
37. The optimal route of administration of antibiotic therapy has not been established. Parenteral, oral, or initial parenteral therapy followed by oral therapy may be used depending on individual patient circumstances (A-III).
38. Antibiotics available for parenteral administration include IV vancomycin (B-II) and daptomycin 6 mg/kg/dose IV once daily (B-II). Some antibiotic options with parenteral and oral routes of administration include the following: TMP-SMX 4 mg/kg/dose (TMP component) twice daily in combination with rifampin 600 mg once daily (B-II), linezolid 600 mg twice daily (B-II), and clindamycin 600 mg every 8 hours (B-III).
39. Some experts recommend the addition of rifampin 600 mg daily or 300–450 mg PO twice daily to the antibiotic chosen above (B-III). For patients with concurrent bacteremia, rifampin should be added after clearance of bacteremia.
40. The optimal duration of therapy for MRSA osteomyelitis is unknown. A minimum 8-week course is recommended (A-II). Some experts suggest an additional 1–3 months (and possibly longer for chronic infection or if debridement is not performed) of oral rifampin-based combination therapy with TMP-SMX, doxycycline-minocycline, clindamycin, or a fluoroquinolone, chosen on the basis of susceptibilities (C-III).
41. Magnetic resonance imaging (MRI) with gadolinium is the imaging modality of choice, particularly for detection of early osteomyelitis and associated soft-tissue disease (A-II). Erythrocyte sedimentation rate (ESR) and/or C-reactive protein (CRP) level may be helpful to guide response to therapy (B-III).

Septic Arthritis

42. Drainage or debridement of the joint space should always be performed (A-II).
43. For septic arthritis, refer to antibiotic choices for osteomyelitis (recommendation 37 above). A 3–4-week course of therapy is suggested (A-III).

Device-Related Osteoarticular Infections

44. For early-onset (<2 months after surgery) or acute hematogenous prosthetic joint infections involving a stable implant with short duration (≤3 weeks) of symptoms and debridement (but device retention), initiate parenteral therapy (refer to antibiotic recommendations for osteomyelitis) plus rifampin 600 mg daily or 300–450 mg PO twice daily for 2 weeks followed by rifampin plus a fluoroquinolone, TMP-SMX, a tetracycline or clindamycin for 3 or 6 months for hips and knees, respectively (A-II). Prompt debridement with device removal whenever feasible is recommended for unstable implants, late-onset infections, or in those with long duration (>3 weeks) of symptoms (A-II).
45. For early-onset spinal implant infections (≤30 days after surgery) or implants in an actively infected site, initial parenteral therapy plus rifampin followed by prolonged oral therapy is recommended (B-II). The optimal duration of parenteral and oral therapy is unclear; the latter should be continued until spine fusion has occurred (B-II). For late-onset infections (>30 days after implant placement), device removal whenever feasible is recommended (B-II).

46. Long-term oral suppressive antibiotics (e.g., TMP-SMX, a tetracycline, a fluoroquinolone [which should be given in conjunction with rifampin due to the potential emergence of fluoroquinolone resistance, particularly if adequate surgical debridement is not possible], or clindamycin) with or without rifampin may be considered in selected cases, particularly if device removal is not possible (B-III).

Pediatric Considerations

47. For children with acute hematogenous MRSA osteomyelitis and septic arthritis, IV vancomycin is recommended (A-II). If the patient is stable without ongoing bacteremia or intravascular infection, clindamycin 10–13 mg/kg/dose IV every 6–8 hours (to administer 40 mg/kg/day) can be used as empirical therapy if the clindamycin resistance rate is low (e.g., <10%) with transition to oral therapy if the strain is susceptible (A-II). The exact duration of therapy should be individualized, but typically a minimum 3–4-week course is recommended for septic arthritis and a 4–6-week course is recommended for osteomyelitis.
48. Alternatives to vancomycin and clindamycin include the following: daptomycin 6 mg/kg/day IV once daily (C-III) or linezolid 600 mg PO/IV twice daily for children ≥12 years of age and 10 mg/kg/dose every 8 hours for children <12 years of age (C-III).

What is the management of MRSA infections of the Central Nervous System (CNS)?

Meningitis

49. IV vancomycin for 2 weeks is recommended (B-II). Some experts recommend the addition of rifampin 600 mg daily or 300–450 mg twice daily (B-III).
50. Alternatives include the following: linezolid 600 mg PO/IV twice daily (B-II) or TMP-SMX 5 mg/kg/dose IV every 8–12 hours (C-III).
51. For CNS shunt infection, shunt removal is recommended, and it should not be replaced until cerebrospinal fluid (CSF) cultures are repeatedly negative (A-II).

Brain Abscess, Subdural Empyema, Spinal Epidural Abscess

52. Neurosurgical evaluation for incision and drainage is recommended (A-II).
53. IV vancomycin for 4–6 weeks is recommended (B-II). Some experts recommend the addition of rifampin 600 mg daily or 300–450 mg twice daily (B-III).
54. Alternatives include the following: linezolid 600 mg PO/IV twice daily (B-II) and TMP-SMX 5 mg/kg/dose IV every 8–12 hours (C-III).

Septic Thrombosis of Cavernous or Dural Venous Sinus

55. Surgical evaluation for incision and drainage of contiguous sites of infection or abscess is recommended whenever possible (A-II). The role of anticoagulation is controversial.
56. IV vancomycin for 4–6 weeks is recommended (B-II). Some experts recommend the addition of rifampin 600 mg daily or 300–450 mg twice daily (B-III).
57. Alternatives include the following: linezolid 600 mg PO/IV twice daily (B-II) and TMP-SMX 5 mg/kg/dose IV every 8–12 hours (C-III).

Pediatric Considerations

58. IV vancomycin is recommended (A-II).

What is the role of adjunctive therapies for the treatment of MRSA infections?

59. Protein synthesis inhibitors (e.g., clindamycin and linezolid) and intravenous immunoglobulin (IVIG) are not routinely recommended as adjunctive therapy for the management of invasive MRSA disease (A-III). Some experts may consider these agents in selected scenarios (e.g., necrotizing pneumonia or severe sepsis) (C-III).

What are the recommendations for vancomycin dosing and monitoring?

These recommendations are based on a consensus statement of the American Society of Health-System Pharmacists, the IDSA, and The Society of Infectious Diseases Pharmacists on guidelines for vancomycin dosing (Rybak et al., "Therapeutic monitoring," 2009; Rybak et al., "Vancomycin therapeutic," 2009).

Adults

60. IV vancomycin 15–20 mg/kg/dose (actual body weight) every 8–12 hours, not to exceed 2 grams per dose, is recommended in patients with normal renal function (B-III).
61. In seriously ill patients (e.g., those with sepsis, meningitis, pneumonia, or infective endocarditis) with suspected MRSA infection, a loading

dose of 25–30 mg/kg (actual body weight) may be considered. (Given the risk of red man syndrome and possible anaphylaxis associated with large doses of vancomycin, one should consider prolonging the infusion time to 2 hours and use of an antihistamine prior to administration of the loading dose.) (C-III).

62. Trough vancomycin concentrations are the most accurate and practical method to guide vancomycin dosing (B-II). Serum trough concentrations should be obtained at steady state conditions, prior to the fourth or fifth dose. Monitoring of peak vancomycin concentrations is not recommended (B-II).
63. For serious infections, such as bacteremia, infective endocarditis, osteomyelitis, meningitis, pneumonia, and severe SSTI (e.g., necrotizing fasciitis) due to MRSA, vancomycin trough concentrations of 15–20 micrograms (mcg)/mL are recommended (B-II).
64. For most patients with SSTI who have normal renal function and are not obese, traditional doses of 1 gram every 12 hours are adequate, and trough monitoring is not required (B-II).
65. Trough vancomycin monitoring is recommended for serious infections and patients who are morbidly obese, have renal dysfunction (including those receiving dialysis), or have fluctuating volumes of distribution (A-II).
66. Continuous infusion vancomycin regimens are not recommended (A-II).

Pediatrics

67. Data are limited to guide vancomycin dosing in children. IV vancomycin 15 mg/kg/dose every 6 hours is recommended in children with serious or invasive disease (B-III).
68. The efficacy and safety of targeting trough concentrations of 15–20 mcg/mL in children requires additional study but should be considered in those with serious infections, such as bacteremia, infective endocarditis, osteomyelitis, meningitis, pneumonia, and severe SSTI (i.e., necrotizing fasciitis) (B-III).

How should results of vancomycin susceptibility testing be used to guide therapy?

69. For isolates with a vancomycin minimum inhibitory concentration (MIC) ≤2 mcg/mL (e.g., susceptible according to Clinical and Laboratory Standards Institute [CLSI] breakpoints), the patient's clinical response should determine the continued use of vancomycin, independent of the MIC (A-III).
    i. If the patient has had a clinical and microbiologic response to vancomycin, then it may be continued with close follow-up.
    ii. If the patient has not had a clinical or microbiologic response to vancomycin despite adequate debridement and removal of other foci of infection, an alternative to vancomycin is recommended regardless of MIC.

70. For isolates with a vancomycin MIC >2 mcg/mL (e.g., vancomycin-intermediate *S. aureus* [VISA] or vancomycin-resistant *S. aureus* [VRSA]), an alternative to vancomycin should be used (A-III).

What is the management of persistent MRSA bacteremia and vancomycin treatment failures in adult patients?

71. A search for and removal of other foci of infection, drainage or surgical debridement is recommended (A-III).
72. High-dose daptomycin (10 mg/kg/day), if the isolate is susceptible, in combination with another agent (e.g., gentamicin 1 mg/kg IV every 8 hours, rifampin 600 mg PO/IV daily or 300-450 mg PO/IV twice daily, linezolid 600 mg PO/IV BID, TMP-SMX 5 mg/kg IV twice daily, or a beta-lactam antibiotic) should be considered (B-III).
73. If reduced susceptibility to vancomycin and daptomycin is present, options may include the following: quinupristin-dalfopristin 7.5 mg/kg/dose IV every 8 hours, TMP-SMX 5 mg/kg/dose IV twice daily, linezolid 600 mg PO/IV twice daily, or telavancin 10 mg/kg/dose IV once daily (C-III). These options may be given as a single agent or in combination with other antibiotics.

What is the management of MRSA infections in neonates?

Neonatal Pustulosis

74. For mild cases with localized disease, topical treatment with mupirocin may be adequate in full-term neonates and young infants (A-III).
75. For localized disease in a premature or very low-birthweight infant or more-extensive disease involving multiple sites in full-term infants, IV vancomycin or clindamycin is recommended, at least initially, until bacteremia is excluded (A-II).

Neonatal MRSA Sepsis

76. IV vancomycin is recommended, dosing as outlined in the Red Book (A-II) (American Academy of Pediatrics, 2009).
77. Clindamycin and linezolid are alternatives for non-endovascular infections (B-II).

Definitions:

Strength of Recommendation*

A. Good evidence to support a recommendation for or against use.
B. Moderate evidence to support a recommendation for or against use.
C. Poor evidence to support a recommendation.

Quality of Evidence*

I. Evidence from ≥1 properly randomized, controlled trial.
II. Evidence from ≥1 well-designed clinical trial, without randomization; from cohort or case-controlled analytic studies (preferably from >1 center); from multiple time-series; or from dramatic results from uncontrolled experiments.
III. Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

*Adapted from Canadian Task Force on the Periodic Health Examination, 1979. Reproduced with the permission of the Minister of Public Works and Government Services Canada.

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

Infections with methicillin-resistant *Staphylococcus aureus* (MRSA)

Guideline Category

Management

Treatment

Clinical Specialty

Critical Care

Emergency Medicine

Family Practice

Infectious Diseases

Internal Medicine

Neurology

Orthopedic Surgery

Pediatrics

Pharmacology

Pulmonary Medicine

Surgery

Intended Users

Advanced Practice Nurses

Nurses

Pharmacists

Physician Assistants

Physicians

Public Health Departments

Guideline Objective(s)

To provide recommendations on the management of some of the most common clinical syndromes encountered by adult and pediatric clinicians who care for patients with methicillin-resistant *Staphylococcus aureus* (MRSA) infections

Note: The guidelines do not discuss active surveillance testing or other MRSA infection–prevention strategies in health care settings, which are addressed in previously published guidelines.

Target Population

Children, including neonates and very-low-birthweight infants, and adults with infections and associated clinical syndromes due to methicillin-resistant *Staphylococcus aureus* (MRSA)

Interventions and Practices Considered

Management/Treatment

1. Management of methicillin-resistant *Staphylococcus aureus* (MRSA) skin and soft-tissue infections (SSTIs) in adults
    - Incision and drainage
    - Empiric antibiotic therapy
    - Culture-based therapy
2. Management of recurrent MRSA SSTIs
    - Patient education
    - Personal (patients and contacts) and environmental hygiene
    - Decolonization
3. Management of bacteremia and infective endocarditis in adults
    - Antibiotic therapy
    - Debridement at the source of infection
    - Blood cultures
    - Echocardiography
    - Evaluation for valve replacement surgery
4. Management of MRSA pneumonia
    - Antibiotic therapy (empiric or culture-based)
    - Drainage for empyema complication
5. Management of MRSA bone and joint infections (osteomyelitis, septic arthritis, device-related osteoarticular infection
    - Antibiotic therapy
    - Drainage and debridement
    - Diagnosis of osteomyelitis by magnetic resonance imaging with gadolinium
    - Osteomyelitis response evaluation by erythrocyte sedimentation rate and/or C-reactive protein
    - Device removal
6. Management of MRSA central nervous system infections

    - Antibiotic therapy
    - Shunt removal
7. Adjunctive therapies for treating MRSA infections in adults and pediatrics (not recommended)
8. Vancomycin dosing and monitoring in adults and children
9. Vancomycin susceptibility testing to guide therapy
10. Management of persistent MRSA bacteremia and vancomycin treatment failure in adults
11. Other considerations
    - Treatment of pediatric and neonatal patients
    - Route of administration of antibiotics
    - Duration of treatment

Note: Oral antimicrobial therapy, screening cultures, and surveillance cultures for management of recurrent MRSA SSTIs were considered but were not routinely recommended.

Major Outcomes Considered

- Cure/response rate
- Treatment failure rate
- Relapse rate
- Rate of development of antibiotic resistance
- Sensitivity and specificity of clinical monitoring
- Adverse effects of antimicrobial therapy
- Mortality

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

The Expert Panel completed the review and analysis of data published since 1961. Computerized literature searches of PUBMED of the English-language literature were performed from 1961 through 2010 using the terms "methicillin-resistant *Staphylococcus aureus*" or "MRSA" and focused on human studies but also included studies from experimental animal models and in vitro data. A few abstracts from national meetings were included.

Number of Source Documents

Not stated

Methods Used to Assess the Quality and Strength of the Evidence

Expert Consensus

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Quality of Evidence*

I. Evidence from ≥1 properly randomized, controlled trial.
II. Evidence from ≥1 well-designed clinical trial, without randomization; from cohort or case-controlled analytic studies (preferably from >1 center); from multiple time-series; or from dramatic results from uncontrolled experiments.
III. Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

*Adapted from Canadian Task Force on the Periodic Health Examination, 1979. Reproduced with the permission of the Minister of Public Works and Government Services Canada.

Methods Used to Analyze the Evidence

Review of Published Meta-Analyses

Systematic Review

Description of the Methods Used to Analyze the Evidence

In evaluating the evidence regarding the management of methicillin-resistant *Staphylococcus aureus* (MRSA), the Expert Panel followed a process used in the development of other Infectious Diseases Society of America (IDSA) guidelines. The process included a systematic weighting of the quality of the evidence and the grade of recommendation (see the "Rating Scheme for the Strength of the Evidence" and the "Rating Scheme for the Strength of the Recommendations" fields).

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

The Expert Panel met on 7 occasions via teleconference to complete the work of the guideline and at the 2007 Annual Meeting of the Infectious Diseases Society of America (IDSA) and the 2008 Joint Interscience Conference on Antimicrobial Agents and Chemotherapy/IDSA Meeting. The purpose of these meetings was to discuss the questions to be addressed, to make writing assignments, and to deliberate on the recommendations. All members of the panel participated in the preparation and review of the draft guideline. There were few randomized, clinical trials; many recommendations were developed from observational studies or small case series, combined with the opinion of expert panel members.

Rating Scheme for the Strength of the Recommendations

Strength of Recommendation*

A. Good evidence to support a recommendation for or against use.
B. Moderate evidence to support a recommendation for or against use.
C. Poor evidence to support a recommendation.

*Adapted from Canadian Task Force on the Periodic Health Examination, 1979. Reproduced with the permission of the Minister of Public Works and Government Services Canada.

Cost Analysis

A formal cost analysis was not performed and published analyses were not reviewed.

Method of Guideline Validation

External Peer Review

Internal Peer Review

Description of Method of Guideline Validation

Feedback from external peer reviews was obtained. The guideline was reviewed and endorsed by the Pediatric Infectious Diseases Society, the American College of Emergency Physicians, and American Academy of Pediatrics. The guideline was reviewed and approved by the Infectious Diseases Society of America (IDSA) Standards and Practice Guidelines Committee (SPGC) and the IDSA Board of Directors prior to dissemination.

Evidence Supporting the Recommendations

References Supporting the Recommendations

American Academy of Pediatrics. Antibacterial drugs for newborn infants. In: Pickering LK, Baker CJ, Kimberlin DW, Long SS, editor(s). Red book: 2009 report of the committee on infectious diseases. 28 ed. Elk Grove Village (IL): American Academy of Pediatrics; 2009. p. 746.

Rybak M, Lomaestro B, Rotschafer JC, Moellering R Jr, Craig W, Billeter M, Dalovisio JR, Levine DP. Therapeutic monitoring of vancomycin in adult patients: a consensus review of the American Society of Health-System Pharmacists, the Infectious Diseases Society of America, and the Society of Infectious Diseases Pharmacists. Am J Health Syst Pharm. 2009 Jan 1;66(1):82-98. [129 references] PubMed

Rybak MJ, Lomaestro BM, Rotschafer JC, Moellering RC, Craig WA, Billeter M, Dalovisio JR, Levine DP. Vancomycin therapeutic guidelines: a summary of consensus recommendations from the infectious diseases Society of America, the American Society of Health-System Pharmacists, and the Society of Infectious Diseases Pharmacists. Clin Infect Dis. 2009 Aug 1;49(3):325-7. PubMed

Type of Evidence Supporting the Recommendations

The type of supporting evidence is specifically stated for each recommendation (see the "Major Recommendations" field).

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Appropriate treatment and management of adults and children with infections and clinical syndromes due to methicillin-resistant *Staphylococcus aureus* (MRSA)

Potential Harms

- Development of antibiotic-specific resistance
- Adverse effects of antimicrobial therapy

Drug-specific potential harms:

- Trimethoprim-sulfamethoxazole (TMP-SMX) is not recommended in pregnant women in the third trimester, when it is considered pregnancy category C/D, or in infants younger than 2 months of age.
- Tetracyclines are pregnancy category D and are not recommended for children <8 years of age because of the potential for tooth enamel discoloration and decreased bone growth.
- Hexachlorophene should not be used in infants >2 months of age, because it has been linked to adverse neurological outcomes in newborns.
- Daptomycin should not be used in patients with pneumonia because of inactivation by pulmonary surfactant; it can be used in septic pulmonary emboli.

Qualifying Statements

Qualifying Statements

- It is important to realize that guidelines cannot always account for individual variation among patients. They are not intended to supplant physician judgment with respect to particular patients or special clinical situations. The Infectious Diseases Society of America (IDSA) considers adherence to these guidelines to be voluntary, with the ultimate determination regarding their application to be made by the physician in the light of each patient's individual circumstances.
- The findings and conclusions of this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Implementation Tools

Audit Criteria/Indicators

Mobile Device Resources

Pocket Guide/Reference Cards

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Patient-centeredness

Safety

Identifying Information and Availability

Bibliographic Source(s)

Liu C, Bayer A, Cosgrove SE, Daum RS, Fridkin SK, Gorwitz RJ, Kaplan SL, Karchmer AW, Levine DP, Murray BE, Rybak MJ, Talan DA, Chambers HF. Clinical practice guidelines by the Infectious Diseases Society of America for the treatment of methicillin-resistant staphylococcus aureus infections in adults and children. Clin Infect Dis. 2011 Feb;52:1-38. [371 references]

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2011 Feb

Guideline Developer(s)

Infectious Diseases Society of America - Medical Specialty Society

Source(s) of Funding

Infectious Diseases Society of America

Guideline Committee

The Infectious Diseases Society of America (IDSA) Standards and Practice Guidelines Committee (SPGC)

Composition of Group That Authored the Guideline

The IDSA Standards and Practice Guidelines Committee (SPGC): Catherine Liu, Department of Medicine, Division of Infectious Diseases, University of California-San Francisco, San Francisco, California; Arnold Bayer, Division of Infectious Diseases, Harbor-UCLA Medical Center, Torrance, CA, and Department of Medicine, David Geffen School of Medicine at University of California Los Angeles; Sara E. Cosgrove, Division of Infectious Diseases, Johns Hopkins Medical Institutions, Baltimore, Maryland; Robert S. Daum, Department of Pediatrics, Section of Infectious Diseases, University of Chicago, Chicago, Illinois; Scott K. Fridkin, Division of Healthcare Quality Promotion, Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia; Rachel J. Gorwitz, Division of Healthcare Quality Promotion, Center for Emerging and Zoonotic Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia; Sheldon L. Kaplan, Department of Pediatrics, Section of Infectious Diseases, Baylor College of Medicine, Houston, Texas; Adolf W. Karchmer, Division of Infectious Diseases, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts; Donald P. Levine, Department of Medicine, Division of Infectious Diseases, Wayne State University, Detroit Receiving Hospital and University Health Center, Detroit, Michigan; Barbara E. Murray, Division of Infectious Diseases and Center for the Study of Emerging and Re-emerging Pathogens, University of Texas Medical School, Houston, Texas; Michael J. Rybak, Department of Medicine, Division of Infectious Diseases, Wayne State University, Detroit Receiving Hospital and University Health Center, Detroit, Michigan, and Department of Pharmacy Practice, Wayne State University, Detroit, Michigan; David A. Talan, Divisions of Emergency Medicine and Infectious Diseases, Olive View-UCLA Medical Center, Sylmar, CA, and Department of Medicine, David Geffen School of Medicine at University of California Los Angeles; and Henry F. Chambers, Department of Medicine, Division of Infectious Diseases, University of California-San Francisco, San Francisco, California, and Division of Infectious Diseases, San Francisco General Hospital, San Francisco, CA

Financial Disclosures/Conflicts of Interest

All members of the Panel complied with the Infectious Diseases Society of America (IDSA) policy on conflicts of interest, which requires disclosure of any financial or other interest that might be construed as constituting an actual, potential, or apparent conflict. Members of the Panel completed the IDSA conflict of interest disclosure statement and were asked to identify ties to companies developing products that might be affected by promulgation of the guideline. Information was requested regarding employment, consultancies, stock ownership, honoraria, research funding, expert testimony, and membership on company advisory committees. The Panel made decisions on a case-by-case basis as to whether an individual's role should be limited as a result of a conflict. No limiting conflicts were identified.

Potential Conflicts of Interest. H.F.C. has received honoraria and research grants and has served as a consultant to Cubist, Ortho-McNeil, Pfizer, Theravance, and Targanta. S.E.C. has received honoraria from Forest and RibX, has served as a consultant for Merck and has received research support from Astellas, Cubist and AdvanDx. R.D. has received research funding from Pfizer, Clorox, Sanofi Pasteur, Sage, and GeneOhm. S.L.K. has received grant funding from Pfizer, has served as MRSA Leadership Advisor to Pfizer, and is participating in a pediatric daptomycin study. A.W.K. has received honoraria and grants from Cubist Pharmaceuticals, Merck, Wyeth, and Pfizer and has served as a consultant for Cubist Pharmaceuticals, Theravance, Astellas, Pfizer, Merck, and Ortho-McNeil and has owned stock from Cubist Pharmaceutical, Pfizer, and Johnson and Johnson. D.P.L. has received research support from Cubist, Johnson & Johnson, and Theravance and has served as a speaker for Cubist. B.E.M. has served as a consultant and received research support from Johnson & Johnson, Astellas, Pfizer, Cubist, Theravance, Targanta, Sanofi-Aventis, Vicuron Pharmaceuticals, and Wyeth-Ayerst. M.R. has received grants and or has served as a consultant speaker for the Pfizer, Cubist, Theravance/Astellas, Targanta, and Johnson & Johnson. D.A.T. has served on the advisory board to Pfizer, Ortho-McNeil, Astellas, Schering-Plough, and Replidyne. All other authors: no conflicts.

Guideline Status

This is the current release of the guideline.

Guideline Availability

Electronic copies: Available in Portable Document Format (PDF) from the Infectious Diseases Society of America (IDSA) Web site .

Print copies: Available from Catherine Liu, MD, Dept of Medicine, Div of Infectious Diseases, University of California–San Francisco, San Francisco, California, 94102 (catherine.liu@ucsf.edu).

Availability of Companion Documents

The following are available:

- Methicillin-resistant *Staphylococcus aureus* in adults and children. Pocket guide. Infectious Diseases Society of America (IDSA); 2011. 8 p. Electronic copies: Available from the Infectious Diseases Society of America (IDSA) Web site .
- A version of the guideline for mobile devices is available from the Infectious Diseases Society of America (IDSA) Web site .

In addition, performance measures are available in the original guideline document .

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on March 31, 2011. The information was verified by the guideline developer on May 11, 2011. This summary was updated by ECRI Institute on November 22, 2011 following the U.S. Food and Drug Administration (FDA) advisory on Zyvox (linezolid). This summary was updated by ECRI Institute on October 25, 2013 following the U.S. Food and Drug Administration advisory

on Fluoroquinolone Antibacterial Drugs. This summary was updated by ECRI Institute on March 6, 2014 following the U.S. Food and Drug Administration advisory on Over-the-Counter Topical Antiseptic Products.

Copyright Statement

Disclaimer

NGC Disclaimer

The National Guideline Clearinghouseâ„¢ (NGC) does not develop, produce, approve, or endorse the guidelines represented on this site.

All guidelines summarized by NGC and hosted on our site are produced under the auspices of medical specialty societies, relevant professional associations, public or private organizations, other government agencies, health care organizations or plans, and similar entities.

Guidelines represented on the NGC Web site are submitted by guideline developers, and are screened solely to determine that they meet the NGC Inclusion Criteria which may be found at http://www.guideline.gov/about/inclusion-criteria.aspx.

NGC, AHRQ, and its contractor ECRI Institute make no warranties concerning the content or clinical efficacy or effectiveness of the clinical practice guidelines and related materials represented on this site. Moreover, the views and opinions of developers or authors of guidelines represented on this site do not necessarily state or reflect those of NGC, AHRQ, or its contractor ECRI Institute, and inclusion or hosting of guidelines in NGC may not be used for advertising or commercial endorsement purposes.

Readers with questions regarding guideline content are directed to contact the guideline developer.